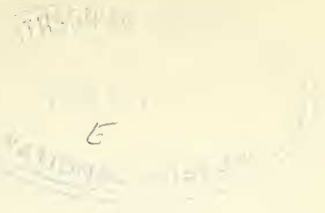


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ART. V. NOTES ON THE REPRODUCTION OF THE NORTHERN
COPPERHEAD, *AGKISTRODON MOKASEN CUPREUS*
(RAFINESQUE), IN PENNSYLVANIA

BY ALBERT G. SMITH
UNIVERSITY OF PITTSBURGH

While assembling material for a distributional study of the Northern Copperhead in Pennsylvania, certain data on the breeding habits and young were secured which are of interest in connection with the results presented by Gloyd (1934) in his excellent account of the reproduction of this subspecies in Kansas.

I am indebted to Mr. M. Graham Netting for guidance in this study, and to the following persons for their helpful assistance: Rev. Maximilian Duman, O.S.B., and Rev. Alfred Grotzinger, O.S.B., Saint Vincent College, Dr. Howard K. Gloyd, Chicago Academy of Sciences, Mr. Roger Conant, Philadelphia Zoological Society, and Mr. George W. Koehler, Pennsylvania Game Commission.

Mating: The only observation upon the mating of the Copperhead in Pennsylvania is Hay's (1891:107) statement: "My friend, Rev. A. M. Hall, brought me from Western Pennsylvania two specimens of this species, which he took while pairing, on the 28th of August." In Kansas, Gloyd (p. 591) found that over 35 per cent of spring-collected adult females had mated shortly before capture and he concludes that the mating season there occurs during April and early May. Mating probably occurs in Pennsylvania following the emergence of the snakes from hibernation in late April or early May. In other snakes in which spring mating is customary occasional autumn matings are known, and Hay's record probably refers to an incident of this nature.

Gravid females: Four gravid females were collected in the latter part of August, 1938. Three (AGS 170-2) were taken between 10 A.M. and noon on August 21 in a dirt and rock dam at the Greensburg reservoir. All the specimens were found on the downstream slope of the dam, which is partially covered with vines; two were resting about two feet apart, inside a crevice, and the third, at a considerable distance from the others, was coiled with about one-half of its body in the sun and the remaining portion in a crevice. The fourth specimen (AGS 160) was taken under a rock in the early afternoon of August 26 at a stone quarry three miles

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northeast of Lycippus. These snakes were sluggish and refused food in captivity, although they drank water as often as it was offered. Gloyd (p. 591) mentions that the majority of his specimens were found under rocks or in crevices.

Parturition: Gloyd (p. 593) states that in his specimens "parturition took place at night in every case except one." Each of the four females collected near Lycippus in 1938 gave birth to her young sometime between 10 A.M. and 1 P.M., while the writer was attending classes, so that the act of parturition was not observed, with the exception of one occasion, when the extrusion of the last individual of a brood was observed at 1 P.M. A female collected at Sunneystown, Montgomery County, in 1934, which was under observation by Mr. George W. Koehler, a Pennsylvania Game Protector, gave birth to the first of a brood of ten young at 6:50 A.M., on Sept. 27, 1934. Mr. Koehler witnessed the birth of the last five young in this brood and has kindly given me permission to publish his careful observations which are embodied in the following table.

TABLE I.

Order of Birth	Labor			Emergence from membrane		
	Begun	Completed	Duration (minutes)	Begun	Completed	Duration (minutes)
6th	9:25 A.M.	9:37 A.M.	12	11:20 A.M.	12:31 P.M.	71
7th	9:42 A.M.	9:53 A.M.	11	12:29 P.M.	12:34 P.M.	5
8th	9:59 A.M.	10:08 A.M.	9	12:45 P.M.	12:39 P.M.	15
9th	10:22 A.M.	10:27 A.M.	5	11:23 A.M.	12:27 P.M.	64
10th	10:33 A.M.	10:39 A.M.	6	12:03 P.M.	12:48 P.M.	45

In this portion of one brood it will be seen that the duration of labor decreased rather regularly, but that the average length of time, a little over eight minutes, compares favorably with Gloyd's (p. 602) statement "The time for a single fetus was about ten minutes." The intervals between births, which were 5, 6, 14, and 6 minutes, appear to have been unusually brief, for Gloyd (p. 602) reports "the young of two females observed in parturition were expelled at intervals of approximately one hour." The period between the completion of parturition and the first signs of emergence from the prenatal membrane varied in these five young from 96 to 196 minutes, averaging 132. Gloyd (p. 603) mentions that the young snakes usually remained quiet within their membranes for nearly 45 minutes, unless rupture of the membrane had occurred in passage through the cloaca, but he states (p. 594) that in the case of one brood the young remained in the membranes for several hours, the delay being ascribed to

the unusual coolness and dampness of the day. It would appear, therefore, that environmental conditions may affect the period during which different broods remain inactive within their membranes, but that there is great individual variation in the snakes of a single brood as well. Furthermore, the length of time between first rupture of the membrane and final emergence, as listed in Table I, is highly variable.

Birth dates: About 1 P.M. on August 23, 1937 a female was found under a small log near the top of a sawdust pile. Excavation of this section of the sawdust pile to a depth of about six inches exposed a group of seven young, presumably those of the female collected. The young exhibited prominent umbilical scars and sulphur-yellow tails. It is impossible to state whether or not they had been born on that day. Rev. Grotzinger's report of a brood born on October 15 represents an unusually late date, but the fact that these young were stillborn may account for their long retention within the body of the female. As indicated in Table II, the dates of birth of Pennsylvania young range from August 23 (or slightly earlier) to October 15, but the majority of births occur between August 28 and September 17. The birth dates of Gloyd's Kansas *cupreus* range from August 23 to September 17, which corresponds closely to the dates of normal birth in Pennsylvania. Ditmar's (1896:23) mention of the birth of one New Jersey litter on August 9 and one on August 10 suggests that young may be born much earlier than August 23 in eastern Pennsylvania.

Number of young: The twenty known Pennsylvania broods are listed in Table II. For nineteen of these the size of the brood is given, indicating a variation in the number of young from three to ten, with broods of five occurring with the greatest frequency. The number of young in twenty Kansas broods varied from two to six, with broods of four occurring most frequently (Gloyd, p. 596). Gloyd has also tabulated the brood variation for the entire range of *A. mokasen*, the extremes being three and nine. Conant (1938:112) mentions two Ohio broods of six and ten young. It is interesting to note that five of the seven females taken at the Greensburg reservoir produced broods of five young. In other species of snakes there is some evidence that the brood size of wide ranging forms tends to be highest in the Appalachian region, and in some instances at least, larger broods in this area appear to be correlated with the larger size attained by the females. In the Copperhead, the size of females producing broods has been recorded in too few cases to justify any attempt to correlate body size of the female and brood size.

TABLE II.
BROODS FROM PENNSYLVANIA FEMALES

Source	Locality	Date of Birth	No. of Young
FMNH 27252	Westmoreland Co., Lycippus	Aug. 23, 1937 ¹	7
Atkinson (1901:153)	Allegheny County	Aug. 28, 1900	6
Stadelman (1929:81)	Captive, probably from Pennsylvania	Aug. 28, 1929	
Stadelman (1928:67)	Captive, probably from Pennsylvania	Aug. 29, 1928	8
Dunn (1915:37)	Delaware Co., Haverford	Sept. 1	7
AGS 160	Westmoreland Co., Lycippus	Sept. 4, 1938	3
CM 18957	Westmoreland Co., Greensburg Reservoir	Sept. 4, 1939	4
AGS 170	Westmoreland Co., Greensburg Reservoir	Sept. 6, 1938	7
AGS 171	Westmoreland Co., Greensburg Reservoir	Sept. 6, 1938	5
CM 18958	Westmoreland Co., Greensburg Reservoir	Sept. 7, 1939	5
Grotzinger ²	Westmoreland Co., Greensburg Reservoir	Sept. 8, 1939	5
Ditmars (1907:425)	Monroe Co., Delaware Water Gap	Sept. 11	9
Grotzinger ²	Westmoreland Co., Greensburg Reservoir	Sept. 14, 1939	5
AGS 172	Westmoreland Co., Greensburg Reservoir	Sept. 17, 1938	5
CM 7726	Montgomery Co., Sunneytown	Sept. 27, 1934	10
Grotzinger ²	Westmoreland Co., Lycippus	Oct. 15, 1939 ⁴	4
CM 9688	Montgomery Co., Sunneytown	1935	5
St. Vincent Dept. Biol.	Westmoreland Co.		5
St. Vincent College Mus.	Westmoreland Co.		5
Koehler ³	Lycoming Co., Little Bear Creek		9

¹ See explanation above.

² Letter to the author of Jan. 15, 1940.

³ Letter to M. Graham Netting of Oct. 30, 1934.

⁴ Young stillborn.

SUMMARY

1. Mating probably occurs in late April or early May.
2. Four gravid females were found in crevices and under rocks in late August.
3. Parturition, in five known cases, took place during the day.
4. In the last five specimens of one brood the duration of labor for a single fetus varied from 6 to 12 minutes, average, 8. The period between extrusions was from 5 to 14 minutes, average, 8. The young snakes remained within the prenatal membrane from 96 to 196 minutes, average, 132.
5. Although the dates of birth for twenty litters ranged from August 23 to October 15 the majority occurred from August 28 through September 17.
6. The number of young per litter, in nineteen cases, varied from three to ten, with five being the most common.

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